þÿTables in the article of Finnish student teachers their development of 21st-century competencies

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Abstract: This study examined student teachers' perceptions of how well their Teacher Education (TE) had prepared them for 21st-century competencies, and how well they applied these competencies to their teaching. In addition, the study sought to identify best practices, major obstacles, and suggestions to achieve these competencies. The study was implemented in two universities and three universities of applied sciences in Finland that have TE programmes. This study used a mixed-method approach. Data were collected both quantitatively and qualitatively from student teachers (n=227), who assessed 21st-century competencies with a structured questionnaire that included open-ended questions. Quantitative data analysis used descriptive statistics and correlations, while qualitative data analysis used content analysis. The study found that based on the student teachers' self-assessment, the student teachers achieved successfully 21st-century competencies despite differences between competencies. The best-achieved competency was 'Collaboration' and the least well-achieved was 'Global connections.' The study illustrated student teachers' perception of their success in applying 21st-century competencies to their teaching at schools. Answers to open-ended questions produced convincing evidence that courses involving collaborative and interactive learning, high quality, sufficient support, related 21st-century competencies, certain pedagogical methods used by teacher educators, and integrating theory and practice can contribute strongly to the development of student teachers' 21st-century competencies.

Keywords: Student teachers, 21st-century competencies, Teacher education, Learning, Teaching practice

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Table 1 Identification of this study's researched competencies in 21st-century competencies definitions by P21, ATC21S, OECD and the EU

This study researched competencies based on a study by Ravitz (2014)	**P21(https://static.battelleforkids.org/documents/p21/P21_Framework_Definitions_New_Logo_2015_9pgs.pdf.)**	**ATC21S (Binkley et.al, 2012)**	**OECD (2005) (http://www.oecd.org/pisa/35070367.pdf.)**	**EU (2006) (http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32006H0962&from=EN)**
1. Critical thinking **2. Collaboration** **3. Communication** **4. Creativity and innovation** **5. Self-direction** **6. Global connections** **7. Local connections** **8. Using technology as a tool for learning**	Key subjects & 21st century themes: • Language, math, etc. **global awareness, civics, (6,7)** environment, etc. **Information, media & technology skills (8)** Learning & Innovation skills: • **Creativity & innovation (4), critical thinking (1)**, problem-solving, **communication (3), collaboration (2)** Life and career skills: • Flexibility & adaptability, Initiative & **self-direction (5)**, **Social & cross-cultural skills**, Productivity & accountability **(6,7)**, Leadership & **responsibility (6,7)**	Ways of thinking: • **Creativity & innovation (4), critical thinking (1)**, problem-solving, decision-making, learning to learn/metacognition Tools for working: • **Information literacy, ICT literacy (8)** Ways of working: • **Communication (3), collaboration (2)** (teamwork) Ways of living in the world: • **Citizenship (local and global) (6, 7), life & career, personal (5)** and **social responsibility (6, 7)** (including cultural awareness and competencies)	Using tools interactively: • The ability to **use language, symbols, texts, knowledge, information, technology interactively (1, 3, 4, 8)** Interacting in heterogeneous groups: • **The ability to relate well to others, co-operate, work in teams (2)**, manage & resolve conflicts Acting autonomously: • The ability to **act within the big picture, form & conduct life plan & personal projects, defend & assert rights, interests, limits & needs (5, 6, 7)**	**Communication (3)** in the mother tongue **Communication (3)** in foreign language Mathematical competency and basic competency in science and technology **Digital competency (8)** **Learning to learn (1)** **Social and civic competency (2, 3, 6, 7)** **Sense of initiative (5)** and **entrepreneurship (4,5)** **Cultural awareness and expression (3, 6, 7)**

Note: Competencies in this study matched with the competencies in four 21st-century frameworks from number 1 to number 8

Table 2. Competency names and definitions for measuring 21st-century teaching and learning (Hixson, Ravitz and Whisman 2012; Ravitz 2014)

Competency name	**Competency definition**
Critical thinking	being able to analyze complex problems, investigate questions for which there are no clear-cut answers, evaluate different points of view or sources of information, and draw appropriate conclusions based on evidence and reasoning.
Collaboration	being able to work together to solve problems or answer questions, to work effectively and respectfully in teams to accomplish a common goal and to assume shared responsibility for completing a task.
Communication	being able to organize their thoughts, data and findings and share these effectively through a variety of media, as well as orally and in writing.
Creativity and innovation	being able to generate and refine solutions to complex problems or tasks based on synthesis, analysis and then combining or presenting what they have learned in new and original ways.
Self-direction	being able to take responsibility for their learning by identifying topics to pursue and processes for their own learning, and being able to review their own work and respond to feedback.
Global connections	being able to understand global, geo-political issues including awareness of geography, culture, language, history, and literature from other countries.
Local connections	being able to apply what they have learned to local contexts and community issues.
Using technology as a tool for learning	being able to manage their learning and produce products using appropriate information and communication technologies.

Table 3. Participants in this study

Total respondents	Universities		Gender		Primary qualification					
	Two Universities	Three universities of applied sciences	Male	Female	Kindergarten teachers	Class teachers	Subject teachers	Special education teachers	Vocational education teachers	Other teachers
227	125 (55%)	102 (45%)	55 (24%)	172 (76%)	28 (12%)	31 (14%)	48 (21%)	18 (8%)	67 (30%)	35 (15%)

Table 4. Reliability of student teacher 21st-century competencies in their TE and in their teaching practices

Competencies	**Cronbach's Alpha in TE (Part A)**	**Cronbach's Alpha in practice (Part B)**
Critical thinking	.892	.828
Collaboration	.894	.854
Communication	.902	.854
Creativity and innovation	.886	.868
Self-direction	.919	.870
Global connections	.926	.912
Local connections	.924	.909
Using technology as a tool for learning	.914	.846

Table 5. The process of analyzing the qualitative data

CODES (with examples)	CATEGORY	THEME
Courses that were mentioned (e.g., ICT course, history, etc.) Teacher educators' qualities (e.g., ability, competencies, etc.) Teaching methods (e.g., traditional lectures, active learning methods, etc.)	Developing student teachers' 21st-century competencies in the TE programs	Best practices or major obstacles in developing student teachers' 21st-century competencies
Applying theory in practice (e.g., deepening the knowledge, etc.) Learning through practicing (e.g., developing in real teaching, etc.)	Developing student teachers' 21st-century competencies in practice	

Table 6. Student teachers' self-assessment of their 21st-century competencies acquired in their TE

Competencies acquired in TE	**Overall**		**Gender**						**Institutions**					
			Female		Male				Universities		Universities of Applied Sciences			
	M	SD	M	SD	M	SD	*t*-test	Sig.	M	SD	M	SD	*t*-test	Sig.
Critical thinking	3.50	.71	3.50	.66	3.52	.80	-.18	.86	3.53	.57	3.47	.85	.66	.51
Collaboration	3.73	.78	3.74	.78	3.73	.77	.06	.95	3.64	.73	3.85	.81	-2.08	.04*
Communication	3.36	.79	3.35	.75	3.40	.91	-.40	.69	3.25	.72	3.49	.85	-2.32	.02*
Creativity & innovation	3.20	.81	3.17	.78	3.35	.87	-1.43	.16	3.09	.72	3.35	.88	-2.43	.02*
Self-direction	3.39	.84	3.37	.84	3.48	.83	-.84	.41	3.23	.79	3.59	.86	-3.24	.00**
Global connections	2.58	.94	2.54	.90	2.75	1.07	-1.30	.20	2.52	.86	2.66	1.03	-1.08	.28
Local connections	3.01	.92	3.00	.87	3.13	1.04	-.89	.37	2.94	.88	3.11	.95	-1.38	.17
Using technology as a tool for learning	3.24	.84	3.20	.84	3.41	.84	-1.61	.11	3.13	.82	3.39	.85	-2.35	.02*

*$P < .05$; **$P < .01$; Scale of 1-5

Table 7. Student teachers' self-assessment of their 21st-century competencies applied in practice

Competencies applied in practice	**Overall**		**Gender**						**Institutions**					
			Female		Male				Universities		Universities of Applied Sciences			
	M	SD	M	SD	M	SD	*t*-test	Sig.	M	SD	M	SD	*t*-test	Sig.
Critical thinking	3.47	.68	3.45	.66	3.54	.77	-.84	.40	3.35	.66	3.63	.68	-2.84	.01**
Collaboration	3.78	.65	3.80	.66	3.74	.63	.59	.56	3.76	.64	3.81	.67	-.49	.63
Communication	3.60	.63	3.58	.62	3.64	.66	-.53	.60	3.50	.62	3.73	.61	-2.44	.02*
Creativity & innovation	3.49	.68	3.46	.66	3.57	.75	-1.00	.32	3.45	.64	3.53	.74	-.78	.44
Self-direction	3.39	.70	3.32	.67	3.63	.72	-2.63	.01**	3.23	.63	3.60	.75	-3.67	.00**
Global connections	2.93	.95	2.91	.96	2.93	.93	-.14	.89	2.77	.87	3.12	1.01	-2.41	.02*
Local connections	3.24	.77	3.18	.76	3.42	.79	-1.74	.08	3.05	.76	3.49	.72	-3.89	.00**
Using technology as a tool for learning	3.62	.65	3.55	.78	3.81	.78	-2.05	.04*	3.55	.74	3.70	.83	-1.28	.20

*$P < .05$; **$P < .01$; Scale of 1-5

Table 8. Correlations among competencies in TE and in practice, and correlations between competencies acquired in TE and applied in practice

Competencies	1a	2a	3a	4a	5a	6a	7a	8a	1b	2b	3b	4b	5b	6b	7b	8b
1a Critical thinking																
2a Collaboration	.56**															
3a Communication	.67**	.66**														
4a Creativity & innovation	.60**	.58**	.72**													
5a Self-direction	.64**	.62**	.74**	.70**												
6a Global connections	.56**	.41**	.60**	.59**	.55**											
7a Local connections	.56**	.42**	.55**	.61**	.59**	.57**										
8a Using technology as a tool for learning	.52**	.52**	.66**	.63**	70**	.61**	.52**									
1b Critical thinking	.34**															
2b Collaboration		.36**							.49**							
3b Communication			.34**						.51**	.54**						
4b Creativity & innovation				.36**					.41**	.45**	.54**					
5b Self-direction					.35**				.57**	.46**	.57**	.51**				
6b Global connections						.42**			.46**	.32**	.48**	.39**	.52**			
7b Local connections							.40**		.49**	.36**	.54**	.37**	.58**	.58**		
8b Using technology as a tool for learning								.37**	.35**	.31**	.39**	.37**	.54**	.35**	.43**	

1a-8a refer to competencies acquired in TE; 1b-8b refer to competencies applied in teaching practice

*Correlation is significant at the 0.05 level; **Correlation is significant at the 0.01 level

Supplementary material:

Table 9. Reliability of competencies at item level in this study

Competencies	Cronbach's Alpha	Description of the assessed competency items
Critical thinking		
!n TE (Part A)	**.892**	All items
	.874	1. Has helped to compare information from different sources when completing tasks or assignments
	.878	2. Has helped to draw own conclusions based on analysis of numbers, facts, or other relevant information
	.864	3. Has helped to summarize or create own interpretation of what I have read or been taught
	.869	4. Has helped to analyze competing arguments, perspectives or solutions to a problem
	.877	5. Has helped to develop an argument based on valid evidence or reasoning
	.875	6. Has helped to solve complex problems or answer questions that have no single correct solution or answer
In practice (Part B)	**.828**	All items
	.808	1. I can apply methods that support students' critical thinking skills
	.753	2. The students have been motivated to learn critical thinking skills in my class
	.721	3. Based on my observations or assessments, students have learnt critical thinking skills in my class
Collaboration		
In TE (Part A)	**.894**	All items
	.880	1. Has helped to work in pairs or small groups to complete a task together
	.874	2. Has helped to work with peers to set goals and create a plan for our team
	.878	3. Has helped to create joint products using contributions from each person
	.871	4. Has helped to present the group work to the class, teacher or others
	.874	5. Has helped to work as a team to incorporate feedback on group tasks or products
	.878	6. Has helped to give feedback to peers or assess other students' work
In practice (Part B)	**.854**	All items
	.867	1. I can apply methods that support students' collaboration skills
	.761	2. Students have been motivated to learn collaboration skills in my class
	.753	3. Based on my observations or assessments, students have learnt collaboration skills in my class
Communication		
In TE	**.902**	All items

(Part A)	.902	1. Has helped to structure data for use in written or oral presentations (e.g., creating charts, tables or graphs)
	.896	2. Has helped to convey ideas using media other than a written paper (e.g., posters, video, blogs, etc.)
	.878	3. Has helped to prepare and deliver an oral presentation to my teachers or others
	.879	4. Has helped to answer questions in front of an audience
	.880	5. Has helped to decide how I will present my work or demonstrate my learning
	.884	6. Has helped to clearly express myself and listen to other people
	.892	7. Has helped to share my ideas and make compromises
In practice (Part B)	**.854**	All items
	.846	1. I can apply methods that support students' communication skills
	.770	2. Students have been motivated to learn communication skills in my class
	.764	3. Based on my observations or assessments, students have learnt communication skills in my class
Creativity and innovation		
In TE (Part A)	**.886**	All items
	.874	1. Has helped to use idea creation techniques such as brainstorming or concept mapping
	.859	2. Has helped to generate my own ideas about how to confront a problem or question
	.850	3. Has helped to test out different ideas and work to improve them
	.857	4. Has helped to invent a solution to a complex, open-ended question or problem
	.867	5. Has helped to create an original product or performance to express my ideas
In practice (Part B)	**.868**	All items
	.819	1. I can apply methods that support students' creativity and innovation skills
	.840	2. Students have been motivated to learn creativity and innovation skills in my class
	.781	3. Based on my observations or assessments, students have learnt creativity and innovation skills in my class
Self-direction		
In TE (Part A)	**.919**	All items
	.908	1. Has helped to take initiative when confronted with a difficult problem or question
	.906	2. Has helped to choose my own topics of learning or questions to pursue
	.900	3. Has helped to plan the steps which will take to accomplish a complex task
	.902	4. Has helped to choose for myself what examples to study or resources to use
	.900	5. Has helped to monitor my own progress towards completion of a complex task and modify the work accordingly
	.913	6. Has helped to use specific criteria to assess the quality of my work before it is completed
	.921	7. Has helped to use feedback from peers, teachers or experts to revise my work
In practice (Part B)	**.870**	All items
	.857	1. I can apply methods that support students' self-direction skills
	.818	2. Students have been motivated to learn self-direction skills in my class
	.772	3. Based on my observations or assessments, students have learnt self-direction skills in my class
Global connections		
In TE (Part A)	**.926**	All items
	.913	1. Has helped to find information about other countries or cultures
	.912	2. Has helped to use information or ideas that come from colleagues in other countries or cultures
	.922	3. Has helped to discuss issues related to global interdependency (for example, global environment trends, global market economy)
	.914	4. Has helped to work with people from other cultures besides my own and take their life experiences into account
	.902	5. Has helped to use information about the circumstances and geography of different countries
	.911	6.Has helped to reflect on how my own experiences and local circumstances are connected to global issues
In practice (Part B)	**.912**	All items
	.906	1. I can apply methods that support students' skills in making global connections
	.862	2. Students have been motivated to learn skills in making global connection in my class
	.851	3. Based on my observations or assessments students, have learnt skills in making global connection in my class
Local connections		
In TE (Part A)	**.924**	All items
	.906	1. Has helped to investigate topics or issues that are relevant to my family or community
	.906	2. Has helped to apply what I have learned to local situations, issues or problems
	.903	3. Has helped to talk to people in the local communities about a class project or activity
	.915	4. Has helped to analyze how different stakeholder groups or community members view an issue
	.904	5. Has helped to respond to the questions which concern local communities, and take their viewpoints into consideration
In practice (Part B)	**.909**	All items
	.926	1. I can apply methods that support students' skills in making local connections
	.835	2. Students have been motivated to learn skills in making local connection in my class
	.842	3. Based on my observations or assessments, students have learnt skills in making local connection in my class
Using technology as a tool for learning		
In TE (Part A)	**.914**	All items
	.902	1. Has helped to use digital technology or the Internet for self-instruction (e.g., videos, tutorials, self-instructional websites, etc.)

	.898	2. Has helped to select appropriate digital technology tools or resources for completing a task
	.911	3. Has helped to evaluate the credibility and relevance of online information
	.905	4. Has helped to use digital technology to analyze information (e.g., databases, spreadsheets, graphic programs, etc.)
	.897	5. Has helped to use digital technology to help me share information (e.g., multi-media presentations using sound or video, presentation software, blogs, podcasts, etc.)
	.905	6. Has helped to use digital technology to support teamwork or collaboration (e.g., shared workspaces, email exchanges, giving and receiving feedback, etc.)
	.904	7. Has helped to use digital technology to interact directly with experts or members of local/global communities
	.898	8. Has helped to use digital technology to keep track of my work on extended tasks or assignments
In practice (Part B)	**.846**	All items
	.870	1. I can apply methods that support students' skills in using digital technology as a tool for learning
	.775	2. Students have been motivated to learn skills in using digital technology as a tool for learning in my class
	.705	3. Based on my observations or assessments, students have learnt skills in using digital technology as a tool for learning in my class